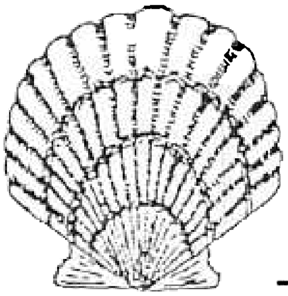

LESSON #5 - WATER QUALITY ISSUES IMPACTING
THE PECONIC BAY ESTUARY SYSTEM

# OBJECTIVES:

1 - Students will discuss the sources of nutrients to marine aquatic systems.

2 - Students will examine brown tide data and discuss its effects on the local marine environment.

# ACTIVITIES:

Set up an algae bloom demonstration

2- Have students play the algae bloom game that demonstrates population growth of algae and predation by zooplankton.

3- Have students construct a flow chart to explore the pros and cons of what happens when brown tide blooms in a bay.

BACKGROUND:

In addition to oxygen, food (nutrients) is another major requirement to sustain life. Plants need nutrients to live, just as animals do. A farmer or gardener must add fertilizer (manure, compost, or commercial fertilizer) to fields annually to replace nitrogen and phosphorus depleted during the growing season and harvest. If not replenished, low concentrations of these nutrients in the soil will be a limiting factor for plant growth. In natural systems, nutrients are continually restored as decaying plant and animal matter break down and release nutrients back into the soil.

Aquatic plants get their nutrients from decomposing plant and animal matter in the water and on surrounding land areas. These nutrients are carried to aquatic environments by streams or storm water runoff, along with nutrients released by the erosion of rocks and soil.

Although nutrients are necessary, in excess they can be harmful to aquatic environments. Problems in water occur when excess nutrients enter these systems due to human activity. Nitrogen and phosphorus enter aquatic systems from fertilizers and animal wastes from farm and lawn runoff, sewage treatment plants and faulty septic systems. An overabundance of these nutrients causes algal blooms that often have detrimental effects on other aquatic life. If an algal bloom produces more plant material than can be consumed by aquatic animals (zooplankton), the excess algae dies and decays. Bacteria that decompose the dead plant matter then rise sharply in number, placing a great demand on available oxygen levels as they respire. If this demand for oxygen is greater than the supply, the result is low dissolved oxygen levels in the water, a condition known as HYPOXIA. Hypoxia kills fish and aquatic invertebrates and speeds up EUTROPHICATION (the process by which a body of water becomes shallow either naturally or by pollution).

Where phosphorus is an important factor in freshwater systems, leading to the banning of phosphorus in detergent in many areas of the country, it is nitrogen that causes blooms in marine systems. Salt marshes are therefore monitored for levels of the nitrogen compounds nitrite ($N0_2$), nitrate ($N0_3$) and ammonia ($NH_3$).

MATERIALS:

- 1 large bag of popcorn (not provided)
- brown paper lunch bags
- paper cups - have extra cups for eating popcorn after activity
- 1 large clear bowl (not provided)

PROCEDURE:

ALGAE BLOOM GAME

1 - Play the "Algae Bloom Game." (This game requires play by 12 students, 8 algae population controllers and 4 zooplankton)

- select 2 students who to be algae population controllers. They will use the cups to place the algae (popcorn) into the water system (bowl). Two different students are zooplankton and they each have a brown paper bag. At the start of the game the algae controllers each add one cup of popcorn to the bowl. The zooplankton are continually feeding on the algae by removing the popcorn one kernel at a time and placing it in their bag. After 30 seconds 2 more algae controllers are added to the game, and all four each add one cup of algae to the bowl. After a minute add two more algae controllers and a new zooplankton. Continue pattern for 1.5 minutes. (See following chart.)

Time in seconds

| | 1-30 | 31-60 | 61-90 | 91-120 |
|---|---|---|---|---|
| algae controllers | 2 | 4 | 6 | 8 |
| zooplankton | 2 | 2 | 3 | 4 |

NOTE: Lag in population increase of zooplankton (second column) represents time lag found in natural biotic systems.

- Although zooplankton continually eat the algae they should not be able to keep up with the additional algae added to the system as a result of excess nutrients. Discuss with students that the popcorn left in the bowl after 2 minutes represents algae that would not be consumed and would die and decay, causing decreased levels in dissolved oxygen.

2 - Discuss with students the brown tide data and its effects on the local shellfish industry. (See Brown Tide Fact Sheet.)

3 - On blackboard, draw flow chart to show the positive and negative effects of brown tide. Have students provide information to fill in boxes. You may need to direct the students by asking specific "What if" questions. Refer to completed chart provided.

## BROWN TIDE

Phytoplankton are single-celled green plants that live in both fresh and marine waters. When conditions are favorable, phytoplankton populations explode resulting in what have become know as "algal blooms." Algal blooms may be caused by a combination of the following factors:

1. abundance and type of nutrients available
2. temperature
3. salinity level
4. amount of sunlight

A bloom may have many negative affects on aquatic environments which include unnatural water color, noxious odors, oxygen depletion, and resulting mortality of animal life.

In the summer of 1985, Long Island and other New England marine waters experienced a new type of algal bloom. The algal bloom turned many bays into a golden brown color and thus the now famous name of "Brown Tide." Brown tide blooms have caused havoc for Long Island's bay scallop fishery. Prior to 1985, Long Island had an annual scallop harvest of 250,000 to 500,000 pounds of scallops worth over $1 million. The brown tide blooms have virtually eliminated the bay scallop fishery on Long Island.

Brown tide does not kill scallops directly but kills the eel grass on which young scallops live. Eel grass beds are critical habitat for the protection and growth of many young fish species, shellfish and especially the bay scallop. The brown tide blooms reduce the clarity of the bay's waters and in turn reduces sunlight penetration levels in the water column. This reduced light impairs the ability of eel grass to photosynthesize and can cause the grasses to die.

In the summer of 1985, some unknown environmental factors triggered the first known brown tide event. Research revealed that the brown tide alga was a previously unknown species. 1985 was also the start of a drought year that marked the lowest annual precipitation in 37 years. Due to low precipitation levels during the winter and spring, the resulting low spring runoff caused higher than normal salinity in the bays.

No clear cut answers or causes have been determined in the recent brown tide blooms. Some possible environmental triggering factors have been hypothesized and are currently being studied. Based on current research, the following conditions seem to trigger blooms: (1) higher than normal salinities in bays caused by dry spells; (2) pulses of freshwater into bays with continuous supply of nutrients; (3) poor grazing of zooplankton on brown tide algae.

The health and future of our bays and the scallop fishery depends on finding answers to what causes the blooms and a permanent solution for controlling them.